

other than lead, and though the attempts to find some satisfactory substitute for the lead cell have been many, the results have been in all cases disappointing; it remains to be seen whether Mr. Edison's iron / nickel-oxide combination will prove any more practical than its forerunners. As yet the trustworthy information concerning its behaviour and durability is too meagre for any prophecy as to its future to be made.

We have left the contents of chapters iv. and v. to the last, as these contain what to many will doubtless prove the most interesting part of the book. In chapter iv., on the properties and behaviour of lead cells, the electrical phenomena which a complete theory of the chemical reactions must explain are described, and in chapter v. the author deals with the theories which have been advanced. The information as to the electrical behaviour is full and comprehensive, and typical curves of charge and discharge under various conditions are given. These points have been very thoroughly studied both in commercial and in experimental cells, and it is perhaps surprising that their theoretical explanation has proved so difficult. Mr. Wade's views were expressed in his paper read before the Institution of Electrical Engineers three years ago, and they are here repeated. The cycle of changes taking place on discharge, reversal and recharge is explained as being due to changes in a complex lead molecule on the one hand, and a similarly complex lead-peroxide molecule on the other. Double sulphation results from the addition of  $(\text{SO}_4)$  groups one by one (with corresponding removal of  $\text{O}_2$  on the peroxide plate), but the process does not go on until the active material has the composition  $\text{Pb}_{12}(\text{SO}_4)_{12}$  (on the assumption of initial composition  $\text{Pb}_{12}$  and  $\text{Pb}_{12}\text{O}_{24}$  respectively) on both plates. When the active materials have the compositions  $\text{Pb}_{12}(\text{SO}_4)_8$  and  $\text{Pb}_{12}\text{O}_8(\text{SO}_4)_8$  the plates are fully discharged. If the current be now kept flowing in the same direction reversal sets in with addition of  $\text{O}_2$  at the negative, and its removal at the positive, and this goes on until  $\text{Pb}_{12}\text{O}_8(\text{SO}_4)_8$  and  $\text{Pb}_{12}(\text{SO}_4)_8$  are formed; continuing the current still in the same direction  $\text{O}_2$  is added and  $(\text{SO}_4)$  removed at the (old) negative and  $(\text{SO}_4)$  removed at the (old) positive, until finally  $\text{Pb}_{12}\text{O}_{24}$  and  $\text{Pb}_{12}$  are reformed, and the cell is fully charged, but with the plates reversed.

This explanation, it is true, helps to explain some of the obscure points in the behaviour of lead and lead peroxide in the accumulator, but it is questionable whether the weight of evidence in its favour is sufficient to justify the assumptions necessary, even though these may be to some extent supported by collateral evidence of a purely chemical nature. The truth of the matter seems to be that at present we cannot go much beyond the double sulphation theory originally put forward in these columns by Gladstone and Tribe. Progress is barred, not so much by want of study of the lead cell as by want of knowledge of the general behaviour of lead compounds during electrolysis, and even by ignorance of the reactions occurring on the electrolysis of sulphuric acid. In these circumstances, we can look for little help from the dissociation theory, nor has it, as Mr. Wade remarks,

thrown any light on the problems presented, and thermochemical calculations cannot be of great assistance either.

We have dealt with Mr. Wade's book at some length, but not at a greater length than its merits deserve. It only remains to give a word of praise to the illustrations, which, especially in the case of the pictures of different grids and supports, are very clearly executed, and considerably enhance the value of the book.

MAURICE SOLOMON.

#### BIOLOGY OF THE LAKE OF GENEVA.

*Le Léman. Monographie limnologique.* Tome troisième, première livraison. Par Prof. F. A. Forel. Pp. 411. (Lausanne: F. Rouge, 1902.)

IN this, the first portion of the third volume of his interesting work, Prof. Forel treats of the biology of the Lake of Geneva, and describes with his customary wealth of detail the various forms of life observed in and upon the waters of the lake. From a biological point of view, Prof. Forel divides the lake into three regions: (a) *littoral*, extending from the shore line down to a depth of fifteen metres; (b) *abyssal* (*profonde*), comprising a layer of water about two metres in depth extending from the littoral region all over the bottom of the lake; (c) *pelagic*, the great mass of water beyond the littoral region and above the abyssal region. The fauna and flora are classified in accordance with these three regions, and as the animals and plants exist in intimate biological relation, they form what Prof. Forel describes as "sociétés," so that there is a "société" pertaining to each region. Descriptions and illustrations are given of the methods and apparatus employed in collecting the organisms in the different regions, and in the sorting out and separation of these organisms when obtained.

The first half of the book is occupied chiefly with a full list of the organisms constituting the fauna and flora of the lake. Prof. Forel enumerates in all nearly one thousand species. Many of these, however, such as the bats and some of the birds, have no claim to be considered natives, but, like *Homo sapiens*, who heads the list, resort to the lake in search of a living. On the other hand, there are many species peculiar to the lake, among which the most interesting are those adapted to live at considerable depths. The most remarkable of these abyssal forms are the blind Crustacea, *Asellus Foreli* and *Niphargus Foreli*, but most of the groups of animals occurring in the lake have representatives in the deep fauna. Among plants, the only peculiar abyssal form is a moss, *Thamnum Lemani*, found at a depth of nearly 200 feet, yet brilliantly green.

In some groups, the lake is very rich in species, while in others it is surprisingly poor. This may be partly due to some groups having been more thoroughly studied than others.

Of the seven species of mammals noted, one, the beaver, is extinct, two, on Prof. Forel's own showing, have not yet been recorded with certainty, while three are classed as "erratic" or adventitious, leaving only the otter as a regular inhabitant. There is a long list of

birds, many of them mere visitors. Of the forty-two species of Entomostraca, only seven are recorded as pelagic, but a large number occur in the deep region.

Of the twenty-six Rotifers recorded, the majority, fifteen, are pelagic. It is probable that further work in the littoral region would considerably extend the list. Many species of Rhizopods extend into the abyssal region, and several are peculiar to it. Among the Algæ, the Diatoms are very numerous, comprising a greater number of species than any other group of organisms, while, on the other hand, the paucity of Desmids is remarkable. Only two species of Closterium represent the typical unicellular group; the only species cited as pelagic is a Hyalotheca, while the genus Staurastrum, so generally present in the plankton of the lakes in this country, is not noted at all.

It is somewhat surprising to find only two Hepatics and three Mosses in Prof. Forel's lists and no Lichens whatever. In dealing with the Mosses, the professor seems to make it a rule only to admit species which are permanently submerged, a rule which, applied all round, would greatly curtail his lists.

The second half of the book is devoted to the study in detail of the plant and animal associations of the various regions and to the discussion of many interesting problems offered by the life of the lake. Into most of these problems, concerning the origin of the various associations, the migrations of the plankton, &c., we cannot here enter, but several of the more interesting points may briefly be noticed.

Prof. Forel insists on the recent origin of the flora and fauna of the lake, in common with those of all regions which have undergone a glacial epoch. He remarks on the cosmopolitan character of the pelagic population. A remarkable fact is the occurrence of Chironomid larvæ and air-breathing Molluscs at great depths. Without any apparent modification of their structure, both these animals seem to be able to adapt themselves to the altered conditions found at the bottom in the deeper parts of the lake when casually transported thither. When brought to the surface, the air-tubes and air-cavity are found to contain water. After exposure for some time in shallow water, they resume the normal mode of breathing. Prof. Forel further points out that those Chironomid larvæ which had become adapted to breathe water would thereby be prevented from rising to the surface to pass into the winged state. He asserts that as a matter of fact they never are observed to emerge from the water except in the littoral region, and discusses the possibility of the insects breeding pedogenetically, as is known to occur with some species, but considers it more probable that they are all casually introduced.

Some notes are given of the occurrence of albino cygnets among the broods of swans on the lake. There is also a reproduction of an interesting old plate, dated 1581, from the Library of Geneva, giving sketches and notes of nineteen species of fishes frequenting the lake. Mention is made of a fungoid disease, attributed to *Saprolegnia ferax*, which attacked the pike in the lake in the years 1886 and 1887, destroying large numbers of all sizes. The work is valuable as a comprehensive summary of the biology of a large lake, and will be of much

service to those who are making similar studies of other lakes.

The second and concluding part of the third volume of Prof. Forel's monograph on the Lake of Geneva will, it is understood, deal with the pile-dwellings, fisheries and other relations of man to the lake.

#### OUR BOOK SHELF.

*A Monograph of the Land and Freshwater Mollusca of the British Isles.* Vol. ii. Part viii. By J. W. Taylor, F.L.S. Pp. 52; 5 pls. col., figs. in text. (Leeds: Taylor Brothers, 1902.)

WITH the present part, this work enters on its long-awaited second volume, containing the systematic portion. The first volume was devoted to a sort of general introduction to the study of the Mollusca, with special reference to British forms, and left much to be desired; but this second section should prove of great value, seeing that for many years past the author, ably seconded by Mr. W. D. Roebuck, has been patiently amassing a large amount of very valuable information concerning the distribution and variation of the British non-marine Mollusca. So extended, however, is the plan on which the work is projected that further co-operation is invited and will, we hope, be readily given.

As compared with other works of its kind, the present one is noteworthy for the greater length at which the various details concerning each species are treated and for the introduction of new features of great importance. Anatomy receives its proper share of attention; but too much space is bestowed, and mostly wasted, on variations that are quite unimportant scientifically. In this section especially, more careful editing is required to remove the too obvious traces of mere compilation and to introduce a better sense of proportion between the different parts.

The geographical distribution of the species is, however, the strong feature of the work, and here an innovation of very great value is introduced, for, besides detailed records in the text, the range of each species in the British Isles is shown on a separate, coloured map, indicating (a) districts from which the author has actually seen specimens, (b) areas for which the species has been recorded by other observers, and (c) regions in which it probably occurs. To these we hope the author will add indication (say by dots) of districts formerly occupied by a species (e.g. *Acanthinula lamellata*) the range of which has become restricted in recent times. Distribution over neighbouring areas of the continent is shown on maps in the text.

The inclusion of forms entirely fossil (e.g. *Glandina* from the Eocene) is another, welcome, new departure, and here, as in the geological histories, we believe, although it is not so stated, Mr. R. B. Newton rendered some assistance (cf. *Journ. Conch.*, x. p. 74).

The illustrations in the text are mostly good, but here and there is one unworthy of the rest (e.g. No. 52).

Plate i., with coloured figures of Testacella, is an excellent example of tri-colour printing, but the artist must surely have had wooden models to draw from.

One would have expected to have found a more modern classification adopted than that set forth on the opening page, but what was selected should have been correctly followed. The branch Euthyneura, which was established by Spengler, and not by Lankester as stated, is not synonymous with the order Pulmonata, which is only one of its subdivisions.

These and other minor blemishes, however, do not affect the value of the work in its entirety, and when completed the author will undoubtedly have made a most important contribution to the literature on the study of our British non-marine Mollusca. (BV)<sup>2</sup>.